Lummus Technology
a CB&I company

LC-FINING®

Overview

This ebullated bed process represents the most efficient way of handling petroleum bottoms and other heavy hydrocarbons for purification or conversion to distillate. The process features high yields and high removal of contaminants in a safe, reliable, easy-to-operate plant at low investment.

The LC-FINING® process has been used for desulfurization, demetallization, Conradson carbon reduction, and hydroprocessing of atmospheric and vacuum resids. Feedstocks processed include the heaviest, high-metals, high-sulfur vacuum resids. Commercial designs and unit operations range from desulfurization at minimum conversion for production of high quality fuel oils, to nearly complete conversion of resid into low sulfur distillate products. Residual product can be used as fuel oil, synthetic crude, or as feedstock to a coker, a visbreaker, or a solvent deasphalter.

Chevron Lummus Global's* (CLG) proprietary, patented design for low pressure hydrogen and heat recovery eliminates most of the high pressure equipment that is required downstream of the reactors in other processes.

Recent advances in the technology include new designs of the reactor internals that increase conversion and throughput. Current designs can process up to 50,000 bpd of heavy vacuum resid in single train systems. As important, these designs can incorporate integrated gasoil and lighter oil hydrotreating or hydrocracking reactors to produce high quality distillates and lighter fuels for today's clean fuels market. They also provide a means to upgrade other streams in the refinery that need further hydroprocessing. Licensees operate units at residual conversion levels between 60 and 90% of the residual charge.

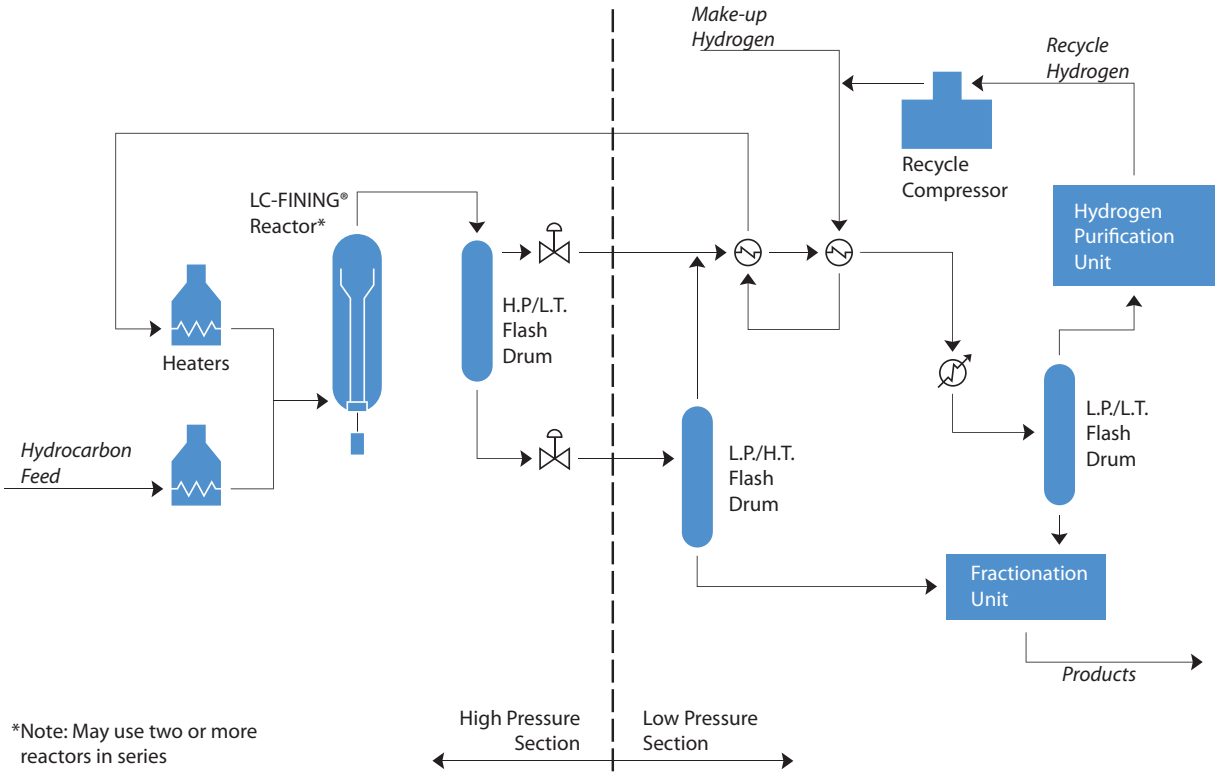
CLG is actively engaged in continually upgrading the LC-FINING process, providing state-of- the-art technology and the most efficient process design.

Chevron Lummus Global, a joint venture between Chevron U.S.A. Inc., a wholly owned subsidiary of Chevron Corporation, and Lummus Technology, a CB&I company

Advantages

Process Features	Process Benefits
Expanded bed reactor with continuous, on-stream addition and withdrawal of catalyst	Long periods of operation without shutdown (5+ years for some operating plants) • No feed quality limitations – handles wide range of heaviest feedstocks • Constant product quality maintained • No reactor pressure drop build-up • Maximizes kinetic effect via continuous good distribution and contacting of catalyst, H_2 and oil • Operation at optimum reactor temperature • Ability to change catalyst type while operating
Advanced reactor section design	Significantly increases throughput and conversion from earlier designs
Advanced controls monitoring and surveillance system	Safe, reliable unit operation • Smooth, fast start-up
Low pressure hydrogen recovery system	Lower gas rates • Lower investment and operating costs
High conversion technology	Maximizes bottoms upgrading to valuable distillates (97% + conversion of resid feed)
Variety of improved catalysts available in a competitive market	Demetallization catalyst allows processing of feedstocks with highest metals content • Desulfurization catalyst allows for production of high quality, low sulfur fuel oil • Best catalyst for CCR reduction and control of product solids content • Reduced catalyst rate

Process Flow Diagram



Process Description

Fresh hydrocarbon liquid feed is mixed with hydrogen and reacted within an expanded catalyst bed that is maintained in turbulence by liquid upflow so as to achieve efficient isothermal operation. Product quality is constantly maintained at a high level by intermittent catalyst addition and withdrawal. Reactor products flow to the high pressure separator, low pressure separator, and then to product fractionation. Recycled hydrogen is separated and purified.

Process features include on-stream catalyst addition and withdrawal, thereby eliminating the need to shut down for catalyst replacement. The expanded bed reactors operate at near isothermal conditions without the need for quenches within the reactor.

The reaction section uses a commercially proven low pressure hydrogen recovery system. Separating the reactor effluent and purifying the recycled hydrogen at low pressure results in lower capital cost and allows design at lower gas rates.

An available process option is the integration of LC-FINING technology with distillate hydrotreating or hydrocracking to produce high quality middle distillate products. This can eliminate the need for additional downstream processing. Unconverted oil from an LC-FINING unit can be sold as a stable, low sulfur fuel oil or sent to another heavy oil conversion unit for further upgrading.

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